

Nucleic acid content in different tissues of the fish, *N. notopterus* in relation to sex

K. Ravikiran*, R. S. Kulkarni

Fish Endocrinology Research Laboratory,
Department of Post Graduate Studies and Research in Zoology,
Gulbarga University Gulbarga – 585 106, Karnataka, India

*E-mail address: ravikiranattimani@gmail.com

ABSTRACT

Nucleic acid content in different tissues in the freshwater fish *N. notopterus* in relation to sex was studied during Pre-spawning phase of the reproductive cycle. The fish were scarified and the tissues such as brain, liver, kidney and gonads removed and processed for determination of nucleic acids. It is observed that the nucleic acid content in different tissues of female fish has lower values than males. The results obtained in the present study may provide a contribution to the knowledge of the characteristics of nucleic acid as parameters of sexing the fish. The study also indicates that although male fish have higher values than female fish, both the sexes are biochemically and nutritionally better.

Keywords: DNA; RNA; *Notopterus notopterus*; *cus04*

1. INTROUDCTION

Nucleic acid content of fish tissues are considerable interest for their specificity in relation to food values of fish and evaluating their physiological needs at different periods of life, fish exhibit large variations in their biochemical content from species to species. Hence, the knowledge of proximate composition of fish is of paramount importance to evaluate in regard to nutrient value and physiological condition (Gershamovich *et al.*, 1984).

Besides nucleic acid content in fish, the fish flesh also offers minerals, iodine, vitamins, fat etc. The knowledge of functional properties of nutrients is important for utilization of the fish in the preparation of value added products. Earlier reports indicate that changes in nucleic acid may occur as a result of gonadal maturity (Dygert, 1990; Montecchia *et al.*, 1997). Such variation might be in all possibility due to difference in the nucleic acid construction of the tissues in respect to size and sex. Hickey (1976) in a brief review pointed out that various factors effects the biochemical contents in fishes as in higher vertebrates. However, sex related variation in biochemical values of fishes are scanty (Poston, 1966). This is important since biochemical values shows conspicuous fluctuation between sexes (Yamashita, 1969).

Sex of the fish may also influence the biochemical parameters. Studies on sexually matured gold fish (*Carassius auratus*) (Summerfelt, 1967) brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo gairdneri*) (Sniezsko, 1960) showed that males consistently had higher packed cell volume values than the females and this study has been proposed as means of sexing fish. In the assessment of the biochemical parameters of gold fish, *Carassius auratus* significantly higher hematological and biochemical values than the female and suggested the need to separate biochemical component data on the basis of sex to avoid attributing sex difference to other factors. Biochemical and nucleic acid measurement can provide valuable tool for monitoring the health and condition of both wild and cultured fish. Physiological indices can offer critical feedback on rearing conditions and nutritional status. The values of the different nucleic acid content are significantly influence the physiological factors and sex of the fish. In the assessment of the biochemical content it was revealed that the sex and period of acclimation may exert some degree of influence on some of the biochemical characteristics of *C. garipepus* (Gabriel *et al.*, 2004) and hence, the need to reckon with these factors in the assessment and reporting of the indices of fish species.

The present study has been undertaken as means of sexing fish and to know the difference between the tissue nucleic acid content of the fish, *N. notopterus* (male and female).

2. MATERIALS AND METHODS

Fresh water fish *N. notopterus* is selected for the present study. This fish is locally available in large in ponds lakes and rivers in and around Gulbarga. The local fisherman popularly called this fish as “Chambari”. Weight of the fish ranges from 80 to 120 gms and length ranges between 18 to 25 cms. The colour of the fish is on the dorsal coppery brown with grayish and silvery colour on the ventral side. Body is highly compressed laterally head is small with large mouth. A dorsal fin, pectoral and pelvic fins, all are small in size anal fin is much elongated and confluent with caudal fin, which is very small or aborted (Gephyrocercal). It is not commercially important fish however; it gaining importance as food in the local area. This fish do not exhibit sexual dimorphism externally and only after sacrifice the male and female can be differentiated based on the gonads.

Around 100 adult fish, *N. notopterus* were collected from Bheema River situated about 40 kms away from Gulbarga city with the help of fisherman during Pre-spawning period of the reproductive cycle (April month) for three year period i.e., 2011-12. The fish were brought to the laboratory and acclimatized for a week before sacrificing for determination of nucleic acids. The fish were scarified and organs such as brain, kidney, liver and gonads removed as processed for determination of nucleic acid. DNA was estimated by the Diphenylamine method (Schneider, 1940) and RNA estimated by the Orcinol (Schneider, 1940). In all the cases six observations were made and the results (DATA) were expressed as arithmetic mean with their standard deviations, standard error and student “t” were as described by Suedecur (1946) and Fisher (1963).

3. RESULTS AND DISCUSSION

Based on the local availability of the fish *N. notopterus* the nucleic acid content such as DNA, RNA were estimated in the different tissues such as brain, liver, kidney and gonads of male and female fresh water fish *N. notopterus* separately during prespawning period (April month).

The studies have been carried out to know the nucleic acid content in the fish and measurements were compared with regard to the sex of the fish. The observations of nucleic acid content in different tissues are as follows. The nucleic acids were determined for three year period i.e., during 2011-12, and data presented in Tables and Figures (Table 1, and Fig. 1). Sex of the fish cannot be identified based on the morphological characteristics. However, they were differentiated after observing gonads as male and Female (Fig. 1).

DNA and RNA content in different tissues of freshwater fish *N. notopterus* in relation to sex (Preparatory phase), indicated that in both male and female fish, the gonads contain higher amount of DNA than other tissues. The degree of DNA content is gonads > liver > brain > kidney. The RNA content also exhibited similar to that of DNA having higher in gonads > liver > brain > kidney. The ratio of DNA/RNA between the tissues of indicates that the brain has 2:1, liver 2:1, testis 2:1 and only in kidney it is 1:1.

The results indicated that the nucleic acids (DNA and RNA) in the male fishes have higher content than female fishes. The observations presented in the table-1, and Fig.1.

Nucleic acid content of fish are closely related to the response of fish to environment and biological factor (Mazom, 2003). For example, in response to ecological and physiological conditions, major changes occur in the fish nucleic acid such as fluctuations in the levels of DNA, RNA concentration and other basic components. Therefore, analysis of nucleic acid indices is a valuable guide in assessing the condition of fish, as it provides a reliable index of their physiological condition, a set of data that is especially important in fish aquaculture. In the present study variation in the values of the nucleic acid content between the two sexes has been noticed. Gabriel *et al.* (2004) revealed that the source of fish (wild or pond) and sex may exert some degrees of influence on some of the characteristics of the fish, *Calarias gariepinus*. Hence, there is a need to reckon with the sex factor in the assessment and reporting some of the indices of fish species.

The measurement of biochemical parameters is a commonly used diagnosis tool in aquatic toxicology and biomonitoring (Xiaoyun *et al.*, 2009). The biochemical composition of a particular living system in the level of organic compounds like proteins, lipids, carbohydrates, amino acids and importantly nucleic acids, which act as source of energy for various physiological functions. The different tissues and organs in an animal are structurally and functionally designed to carry out different physiological processes, it is possible that they will have different organic compositions (Lockwood, 1968). It is known that intrinsic factors like sex greatly influence various physiological processes in a variety of animals (Prosser, 1973). Such variations might be in all possibility due to differences in the biochemical construction of the tissues in respect of size and sex.

Sex of the fish may also influence the blood parameters and nucleic acid content. Studies on sexually matured gold fish (*Carassius auratus*) (Summerfelt, 1967), brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo gairdneri*) (Sniezsko, 1960) showed that males consistently had higher haematocrite values than the females and this has been proposed as means of sexing fish. In the present study, males exhibited higher level of tissue DNA and RNA than female. Similarly Lane (1979) observed significantly higher haematocrite and hemoglobin levels in male versus female in the fish rainbow trout. These differences in hematology with regard to males and females may be related to differential oxygen demand by sex, which in turn may be related to reproductive activity.

The results obtained for a group of fishes belonging to *A. persicus* indicated that mature male fishes have higher serum parameters than immature male fishes (Asadi *et al.*, 2006). In the present study all fishes either male or female are under mature condition and the results indicated that the nucleic acid content in different tissues found to be higher in male fish than female fish.

Although female fish, *N. notopterus* has lower values than males the females are found to be sensitive. The results of this study may be used for monitoring the health. The changes observed in the nucleic acids may reflect the response of fish to changes in their activity. The results obtained in the present study may provide a contribution to the knowledge of the characteristics of nucleic acid as parameters for sexing the fish.

Table 1. Showing 2011-12 year DNA and RNA content (mg/gm) in different tissues of the freshwater fish *N. notopterus* in relation to sex (Preparatory phases).

ORGANS/SEX	BRAIN		LIVER		KIDNEY		GONADS	
	DNA	RNA	DNA	RNA	DNA	RNA	DNA	RNA
MALE	105.1 ± 1.70*** SE ±0.72	40 ± 1.3*** SE ±0.54	115 ± 2 ^{NS} SE ±0.86	46 ± 1.90*** SE ±0.77	52 ± 1.24*** SE ±0.50	43 ± 1.10* SE ±0.45	116 ± 1.20*** SE ±0.49	47 ± 1.2*** SE ±0.49
FEMALE	104 ± 1*** SE ± 0.41	39.2 ± 1*** SE ±0.25	110 ± 2*** SE ±0.81	43 ± 1.28 ^{NS} SE ±0.51	51 ± 1.7*** SE ±0.70	42 ±1. 2 ^{NS} SE ±0.49	112 ± 1.9*** SE ±0.81	45 ± 2.1*** SE ±0.86

Each value is expressed as Mean, Standard Deviation and Standard Error of six observations.

Tukey method used:

* = P < 0.05

** = P < 0.01

*** = P < 0.001

NS = No significant

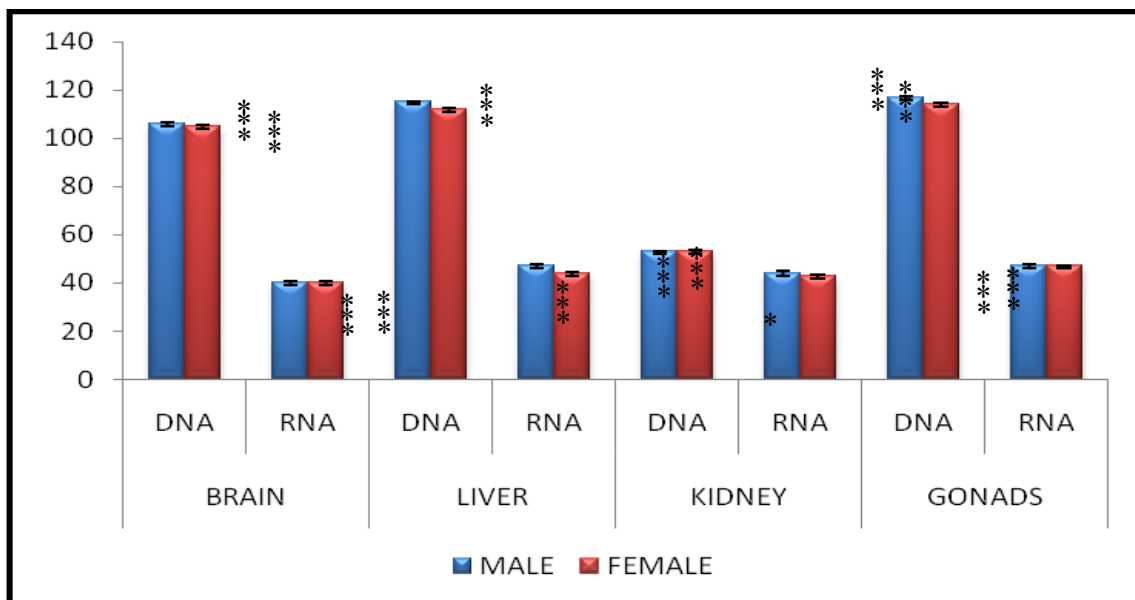


Fig. 1. Showing 2011-12 year DNA and RNA content (mg/gm) in different tissues of the freshwater fish *N. notopterus* in relation to sex.

4. CONCLUSION

Nucleic acid content in different tissues in the freshwater fish *N. notopterus* in relation to sex was studied during Pre-spawning phase of the reproductive cycle. The fish were scarified and the tissues such as brain, liver, kidney and gonads removed and processed for determination of nucleic acids. It is observed that the nucleic acid content in different tissues of female fish has lower values than males. The results obtained in the present study may provide a contribution to the knowledge of the characteristics of nucleic acid as parameters of sexing the fish.

References

- [1] Chicharo, Ana Amaral, Pedro Morais, Luis Chicharo. Effect of sex on ratios and concentrations of DNA and RNA in three marine species, *Marine Ecology progress series* 332:241-245, 2007.
- [2] Clemmesen, C. 1994. The effect of food availability, age or size on the RNA, DNA of individually measured herring larvae, laboratory calibration. *Mar. biol.*, 118:377-382.
- [3] Dasmahapatra, A.K and Medda, A.K. 1978. Seasonal changes in the biochemical activity in the ovary of the fresh water singi fish (*Heteropneustes fossilis*) abstract 65th session of the Indian science congress, Calcutta.
- [4] Fisher, R. 1963. *Statistical methods for research worker*, Ed 6th, Edinburgh. Guraya, S.S. 1976. Recent advances in morphology, histochemistry and biochemistry of steroid synthesizing cellular sites in the testis of the non mammalian vertebrates. *Inter. Rev. of Cytol.*, 47: 99-136.
- [5] Hontela, A and N.E. Stacy. 1990. Cyprinidae. In: *Reproductive seasonality in teleosts. Environmental Influences* A.D. Munro, A.P. Scott and T.J. Lam (Eds). F.L. CRC Press, Boca Raton, p. 53-77.
- [6] Lam, T.J. 1983. Environmental influences on gonadal activity in fishes. In: *Fish Physiology*. W.S. Hoar, D.J. Randall and E.M. Donaldson (Eds.). Academic Press, New York, IXB: 65-116.
- [7] Saleem Mustafa and Zofair. 1985. Seasonal variations in protein, RNA and DNA concentrations in major carps, *Catla catla*, *Labeo rohita* and *Cirrhina mrigala* *Japanese journal of Ichthyology*.
- [8] Schneider. 1940. From the McArdle Memorial Laboratory, Medical School, University of Wisconsin, Madison.
- [9] Sinha, V.R.P., V.G. Jhingran, and S.V. Ganapati. 1974. A view on spawning of the Indian major carps. *Arch. Hydrobiol.*, 73: 518-536.
- [10] Singh, I.J. and Singh, T.P. 1983. Annual changes in the total gonadotropic potency In relation to gonadal activity in the freshwater catfish (*Clarias batrachus* L.). *J. Interdiscipl. Cycle Res.*, 14(3): 227-239.
- [11] Singh, I.J. and Singh, T.P. 1984. Changes in gonadotropin, lipid and cholesterol level During annual reproductive cycle in the freshwater teleost, *Cirrhinus mrigala* (Ham.). *Annales d' Endocrinologie*, 45(2): 131-136.

- [12] Sudarshan and Kulkarni, R.S. 2006. Some aspects of biochemical constituents and hormonal profile in the fresh water fish *Notopterus notopterus*.
- [13] Suedecor, C, W .1946. Statistical methods Iowa state college press Ames Iowa.
- [14] Sundararaj, B.I. and Vasal, S.1976. Photoperiod and temperature control in the regulation of reproduction in the female catfish (*Heteropneustes fossilis*). *J. Fish. Res. Bd., Canada*, 33: 959-973.

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